Respiratory Viruses: Roles of Surfaces, Fomites, and Hands

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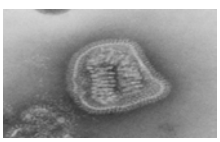
Objectives for Today

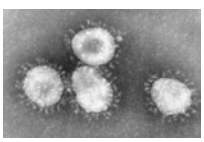
This presentation will briefly address:

- Seasonal respiratory viruses and their modes of transmission
- Survival of these viruses on hands and environmental surfaces
- Strategies to interrupt transmission

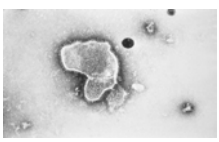
Common Respiratory Viruses



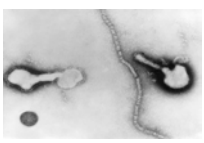
Influenza virus



Coronavirus



Respiratory Syncytial virus



Parainfluenza virus

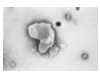
Electron micrographs source: CDC, Public Health Image Library

Viruses as Healthcare-Associated Pathogens

- In 2001, 5% of all healthcare associated infections were attributed to viruses (viewed as an underestimation)
- Pediatric and geriatric patients particularly vulnerable
- Spread in health care mirrors transmission underway in communities
- Asymptomatic infections a problem

Valenti WM, et al. *Infect Control* 1980; 1: 33-37; Aitken C, Jeffries DJ. *Clin Microbiol Rev* 2001; 14: 528-546.

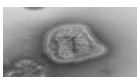
Respiratory Syncytial Virus



- >95% of children seropositive by age 2
- Repeat infections are common
- Winter or spring outbreaks in the U.S.
- Major agent isolated from children admitted with acute lower respiratory tract infection (89%)
  - Bronchiolitis: 43-90% due to RSV
  - Pneumonia: 5-40%
  - Tracheobronchitis: 10-30%
- Acquired immunity is not complete or durable

From: Hall CB, McCarthy CA. Respiratory Syncytial Virus. *in*: Mandel, Bennett, Dolin eds. Principles and Practices of Infectious Diseases, 6th Edition. 2005. Elsevier, Churchill, Livingstone

Influenza Virus

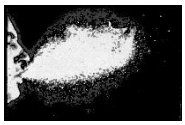


- Influenza A, B, and C
- High mortality rates (10,000 – 51,000 per year)
  - Pneumonia & Influenza mortality statistics are estimate
- Attack rates highest among the young, mortality high among the elderly
- Antigenic drift, antigenic shift

From: Treanor JJ. Influenza Virus. *in*: Mandel, Bennett, Dolin eds. Principles and Practices of Infectious Diseases, 6th Edition. 2005. Elsevier, Churchill, Livingstone

Transmission of Respiratory Viruses

- Large or small (< 5µm median diameter) droplets
  - Large droplets in close person-to-person contact
    - mucous membrane contact
  - Small droplets in coughs, sneezes, talking
- Hand contamination and transferral from surfaces, fomites



Airborne/Droplet Transmission of Pathogens from Healthcare Personnel to Patients

Pathogen	Circumstance
Influenza virus	Lack of vaccination
Varicella-zoster virus	Disseminated infection
Mycobacterium tuberculosis	Cavitary disease
Bordetella pertussis	Undiagnosed prolonged cough
Staphylococcus aureus	Viral URI ("cloud" healthcare provider)

Sherertz RJ et al. *Emerg Infect Dis* 2001; 7: 241-244

Chain of Infection

- Virulent pathogen
- Sufficient number of the pathogen (i.e., infectious dose)
- Susceptible host
- Mode of transmission
- Correct portal of entry

Environmental Surfaces

- Environmental surfaces (e.g., walls, floors) are not directly involved in infectious disease transmission
- These surfaces, however, may serve as reservoirs of microorganisms that may potentially cause infection when transferred from the surface to patients via hands or aerosol-producing activities

The Spaulding Classification

- Categories are based on the potential for a surface to transmit infection should contamination be present at time of use
- Medical instruments:
  - Critical, Semi-critical, Non-critical
- Environmental surfaces
  - CDC modification
  - Surfaces with minimal potential for disease transmission
  - Medical equipment surfaces and housekeeping surfaces

"How Long Does It Live?!?"

- <1 – 5 days:

  Bacteria: *Neisseria meningitidis, Mycoplasma pneumoniae, Hemophilus influenzae, Pseudomonas aeruginosa, Burkholderia pseudomallei*

  Viruses: Rubeola virus (measles), mumps virus, parainfluenza viruses, RSV, VZV, rubella virus, rhinoviruses, SARS-CoV, hepatitis C virus (HCV)

"How Long Does It Live?!?"

- < 1 month

  Bacteria: *Bordetella pertussis, Streptococcus pneumoniae, Yersinia pestis*

  Viruses: Influenza viruses, norovirus, hepatitis B virus (HBV)*

* Note: HBV survival studies indicate the virus can persist on environmental surfaces for <u>at least</u> 7 days; long term survivability not determined

Resistance Levels of Microorganisms

Bacterial Spores
↓
Mycobacteria
↓
Non-lipid or small viruses
↓
Fungi
↓
Vegetative bacteria
↓
Lipid or medium-sized viruses

Choosing a Disinfectant Procedure

- Nature of the item to be disinfected
- Concentration of microorganisms present
- Innate resistance of those microorganisms
- Amount of organic soil
- Type and concentration of germicide used
- Duration and temperature of germicide contact
- Other factors if using a proprietary product

Low-Level Disinfection

- Inactivates vegetative bacteria, some fungi, medium – large viruses, viruses with lipid-containing envelopes
- Quaternary ammonium compounds, some phenolics, some iodophors

Intermediate-Level Disinfection

- Does not necessarily kill bacterial spores, but does inactivate *Mycobacterium tuberculosis* var. *bovis* which is more resistant to germicides than vegetative bacteria, viruses, fungi
- Chlorine-containing compounds, alcohols, some phenolics, and some iodophors

The Inanimate Environment Can Facilitate Transmission

~ Contaminated surfaces increase cross-transmission ~

Abstract: The Risk of Hand and Glove Contamination after Contact with a VRE (+) Patient Environment. Hayden M, ICAAC, 2001, Chicago, IL.

Cleaning and Disinfecting of the Housekeeping Surfaces

- Clean on a regular basis to remove soil and dust
- The actual physical removal of organic soil and microorganisms is as important as the antimicrobial effect of the cleaning or disinfecting agent
- Surfaces not touched frequently by hand (i.e., floors) in general care areas are cleaned and disinfected
  - Debate continues

Cleaning and Disinfecting of the Housekeeping Surfaces

- Follow manufacturer's instructions if using proprietary cleaners or disinfectants
  - Use conditions (e.g., concentration, contact time)
- Clean and disinfect surfaces that are touched by hand on a frequent and regular basis
  - Door knobs, light switches, bed rails
  - Surfaces around the toilet

Cleaning and Disinfecting of Medical Equipment

- FOLLOW THE MANUFACTURER'S INSTRUCTIONS!!!
- In the absence of instructions, clean and follow with low- intermediate-level disinfection depending on the degree of contamination
- Consider covering those surfaces that are frequently touched during delivery of care or cannot be disinfected

Environmental Control of Avian Influenza Virus

- Basic biophysical and biochemical properties of avian influenza virus have not changed
  - Enveloped virus
- Sensitivity to disinfectants predicted to be equivalent to that for human influenza viruses
- Infection control strategy for environmental surfaces will be similar to current protocols
  - Focus on clinical touch surfaces
  - Cleaning, low-level disinfection

Respiratory Hygiene / Cough Etiquette

- Cover the nose and mouth when coughing or sneezing
- Use tissues to contain secretions; dispose properly
- Perform hand hygiene (e.g., hand washing, or alcohol-based hand rub, or antiseptic hand wash)

Additional resource:
www.cdc.gov/flu/protect/covercough.htm

Personal Protective Equipment

- As indicated for Standard Precautions and/or Droplet Precautions
- Masks
  - Surgical or procedural mask
- Gloves
  - Anticipated hand contact with respiratory secretions
- Gowns
  - Intubations, holding the patient close
- N95 Respirators
  - Small particle aerosol generating procedures (e.g., endotracheal intubation, nebulizer treatment)

Break the Chain of Infection

FACT: Healthcare personnel can spread pathogens from patient to patient.

ACTION:

- Stay at home when you are sick
- Respiratory hygiene/cough etiquette
- Keep your hands clean
- Set an example!

So Why All the Fuss About Hand Hygiene?

- *Most common mode of transferral of pathogens is via the hands!*
- Infections acquired in healthcare
- Spread of antimicrobial resistance

Evidence of Relationship Between Hand Hygiene and Healthcare-Associated Infections

- Substantial evidence that hand hygiene reduces the incidence of infections
- Historical study: Semmelweis
- More recent studies: rates lower when antiseptic handwashing was performed

Guideline for Hand Hygiene in Health-care Settings. *MMWR 2002*; vol. 51, no. RR-16.

Hand Hygiene Adherence in Hospitals

Year of Study	Adherence Rate	Hospital Area
1994 (1)	29%	General and ICU
1995 (2)	41%	General
1996 (3)	41%	ICU
1998 (4)	30%	General
2000 (5)	48%	General

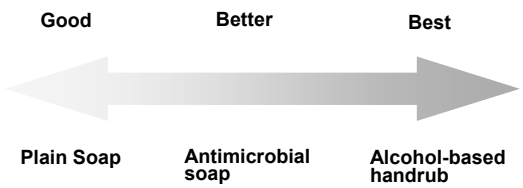
1. Gould D, *J Hosp Infect* 1994;28:15-30. 2. Larson E, *J Hosp Infect* 1995;30:88-106. 3. Slaughter S, *Ann Intern Med* 1996;3:360-365. 4. Watanakunakorn C, *Infect Control Hosp Epidemiol* 1998;19:858-860. 5. Pittet D, *Lancet* 2000:356;1307-1312.

Indications for Hand Hygiene

- When hands are visibly dirty, contaminated, or soiled, wash with non-antimicrobial or antimicrobial soap and water.
- If hands are not visibly soiled, use an alcohol-based handrub for routinely decontaminating hands.

Guideline for Hand Hygiene in Health-care Settings. *MMWR 2002*; vol. 51, no. RR-16.

Efficacy of Hand Hygiene Preparations in Killing Bacteria



Recommended Hand Hygiene Technique

- Handrubs
  - Apply to palm of one hand, rub hands together covering all surfaces until dry
  - Volume: based on manufacturer
- Handwashing
  - Wet hands with water, apply soap, rub hands together for at least 15 seconds
  - Rinse and dry with disposable towel
  - Use towel to turn off faucet

Guideline for Hand Hygiene in Health-care Settings. *MMWR 2002*; vol. 51, no. RR-16.

Time Spent Cleansing Hands:
One Nurse per 8 Hour Shift

- Hand washing with soap and water: 56 minutes
  - Based on seven (60 second) handwashing episodes per hour
- Alcohol-based handrub: 18 minutes
  - Based on seven (20 second) handrub episodes per hour

~ Alcohol-based handrubs reduce time needed for hand disinfection ~

Voss A and Widmer AF, *Infect Control Hosp Epidemiol* 1997:18;205-208.

Summary
Alcohol-Based Handrubs:
What Benefits do They Provide?

- Require less time
- More effective for standard handwashing than soap
- More accessible than sinks
- Reduce bacterial counts on hands
- Improve skin condition

Education/Motivation Programs

- Monitor healthcare workers (HCWs) adherence with recommended hand hygiene practices and give feedback
- Implement a multidisciplinary program to improve adherence to recommended practices
- Encourage patients and their families to remind HCWs to practice hand hygiene

Guideline for Hand Hygiene in Health-care Settings. *MMWR 2002*; vol. 51, no. RR-16.

Measures to Prevent Spread of Respiratory Viruses

- Education of staff
- Strict adherence to infection control policies
- Avoid working while sick
- HANDWASHING / HAND HYGIENE
- Avoid breaks in hygienic practices
- Vaccinations, anti-viral therapies as applicable
- Personal protective equipment as appropriate
- Patient management as appropriate

Some Thoughts in Closing

" In general, it should be kept in mind that the use of disinfectants is only one part of an evidence based, multimodal strategy to control healthcare-related infections and to prevent the spread of resistance. Well-designed studies that systematically investigate the effects of specific interventions in this area are urgently required to support a rational approach to hospital disinfection."

Dettenkofer M, Block C. Hospital disinfection: efficacy and safety issues. *Curr Opin Infect Dis* 2005; 18: 320-325.

Additional Information Resources

- Pandemic influenza
  - www.cdc.gov/flu/pandemic/healthprofessional.htm#infection
  - www.who.int/csr/disease/influenza/pandemic10things/en/index.html
- Current CDC/HICPAC guidelines
  - www.cdc.gov/ncidod/dhqp/gl_environfection.html
  - www.cdc.gov/ncidod/dhqp/gl_handhygiene.html
  - http://www.cdc.gov/ncidod/dhqp/gl_hcpneumonia.html
- Other sources of information
  - http://www.ifh-homehygiene.org/2003/index.html
  - http://www.h2e-online.org/

Thank You!

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"Protect patients, protect health care personnel, and promote safety, quality, and value in the health care delivery system"